Appendix B

ENERGY CONSUMPTION AND PEAK POWER DEMAND OF THE RADIANT COOLING AND ALL-AIR SYSTEMS: RESULTS OF THE PARAMETRIC STUDY

TABLE B.1. Energy Consumption and Peak Power Demand in New Orleans. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	14.8	64.7	11.8	63.6
Air latent energy [kWh_{th}]	34.6	35.5	21.7	24.3
Water sensible energy [kWh_{th}]	34.1	-	34.7	-
Chiller energy [kWh_e]	27.8	33.4	22.7	29.3
Fan energy [kWh_e]	1.3	5.7	1.0	7.3
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	29.3	39.1	23.9	36.6
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.30	1.44	0.33	1.38
Air latent [kW_{th}]	0.69	0.51	0.54	0.63
Water sensible [kW_{th}]	0.78	-	0.93	-
Fan and pump [kW_e]	0.03	0.19	0.03	0.19
Peak load [kW_e]	0.62	0.84	0.63	0.86

TABLE B.2. Energy Consumption and Peak Power Demand in Cape Hatteras. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	8.0	55.0	6.3	55.4
Air latent energy [kWh_{th}]	29.0	30.5	17.5	18.5
Water sensible energy [kWh_{th}]	33.2	-	33.7	-
Chiller energy [kWh_e]	23.4	28.5	19.2	24.6
Fan energy [kWh_e]	1.3	5.2	1.0	6.7
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	24.9	33.7	20.4	31.3
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.30	1.41	0.27	1.47
Air latent [kW_{th}]	0.75	0.69	0.75	0.69
Water sensible [kW_{th}]	0.90	-	0.93	-
Fan and pump [kW_e]	0.03	0.19	0.03	0.20
Peak load [kW_e]	0.68	0.89	0.68	0.92

TABLE B.3. Energy Consumption and Peak Power Demand in New York City. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	4.6	36.9	4.5	40.6
Air latent energy [kWh_{th}]	6.2	6.5	5.1	5.7
Water sensible energy [kWh_{th}]	32.4	-	33.7	-
Chiller energy [kWh_e]	14.4	14.5	14.4	15.4
Fan energy [kWh_e]	1.3	4.7	1.0	6.1
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	15.9	19.2	15.6	21.5
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.30	1.23	0.30	1.17
Air latent [kW_{th}]	0.45	0.45	0.45	0.54
Water sensible [kW_{th}]	0.81	-	0.84	-
Fan and pump [kW_e]	0.03	0.15	0.03	0.16
Peak load [kW_e]	0.55	0.71	0.56	0.73

TABLE B.4. Energy Consumption and Peak Power Demand in Fort Worth. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	12.2	65.1	8.8	64.5
Air latent energy [kWh_{th}]	29.3	33.1	17.8	20.7
Water sensible energy [kWh_{th}]	33.8	-	34.5	-
Chiller energy [kWh_e]	25.1	32.7	20.4	28.4
Fan energy [kWh_e]	1.3	5.4	1.0	7.4
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	26.6	38.1	21.6	35.8
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.39	1.62	0.39	1.68
Air latent [kW_{th}]	0.33	0.30	0.33	0.48
Water sensible [kW_{th}]	1.02	-	1.05	-
Fan and pump [kW_e]	0.03	0.18	0.03	0.18
Peak load [kW_e]	0.61	0.82	0.62	0.90

TABLE B.5. Energy Consumption and Peak Power Demand in Chicago. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	6.0	49.2	4.9	51.6
Air latent energy [kWh_{th}]	7.2	8.3	4.1	5.3
Water sensible energy [kWh_{th}]	34.4	-	34.8	-
Chiller energy [kWh_e]	15.9	19.2	14.6	18.6
Fan energy [kWh_e]	1.3	6.8	1.0	8.2
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	17.4	26.0	15.8	26.8
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.33	1.32	0.33	1.32
Air latent [kW_{th}]	0.36	0.51	0.42	0.48
Water sensible [kW_{th}]	0.96	-	0.93	-
Fan and pump [kW_e]	0.03	0.14	0.03	0.16
Peak load [kW_e]	0.58	0.75	0.59	0.76

TABLE B.6. Energy Consumption and Peak Power Demand in Boston. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	4.0	34.4	3.5	37.6
Air latent energy [kWh_{th}]	2.9	3.0	1.9	2.3
Water sensible energy [kWh_{th}]	32.8	-	32.9	-
Chiller energy [kWh_e]	13.3	12.5	12.8	13.1
Fan energy [kWh_e]	1.3	4.9	1.0	6.1
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	14.8	17.4	14.0	19.2
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.33	1.50	0.33	1.53
Air latent [kW_{th}]	0.36	0.36	0.36	0.36
Water sensible [kW_{th}]	0.96	-	0.99	-
Fan and pump [kW_e]	0.03	0.19	0.03	0.19
Peak load [kW_e]	0.58	0.81	0.59	0.82

TABLE B.7. Energy Consumption and Peak Power Demand in San Jose, CA. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	7.7	45.2	6.9	47.9
Air latent energy [kWh_{th}]	5.8	5.7	4.9	5.4
Water sensible energy [kWh_{th}]	33.9	-	34.0	-
Chiller energy [kWh_e]	15.8	17.0	15.3	17.8
Fan energy [kWh_e]	1.3	5.2	1.0	6.2
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	17.3	22.2	16.5	24.0
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.36	1.44	0.36	1.50
Air latent [kW_{th}]	0.60	0.60	0.63	0.60
Water sensible [kW_{th}]	0.87	-	0.87	-
Fan and pump [kW_e]	0.03	0.17	0.03	0.18
Peak load [kW_e]	0.64	0.85	0.65	0.88

TABLE B.8. Energy Consumption and Peak Power Demand in Phoenix. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	22.4	101.3	15.8	98.7
Air latent energy [kWh_{th}]	3.4	3.5	2.8	2.9
Water sensible energy [kWh_{th}]	52.9	-	53.9	-
Chiller energy [kWh_e]	26.2	34.9	24.2	33.9
Fan energy [kWh_e]	1.3	8.3	1.0	10.0
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	27.7	43.2	25.4	43.9
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.27	2.16	0.33	2.25
Air latent [kW_{th}]	0.42	0.18	0.39	0.18
Water sensible [kW_{th}]	1.23	-	1.23	-
Fan and pump [kW_e]	0.03	0.25	0.03	0.28
Peak load [kW_e]	0.67	1.03	0.68	1.09

TABLE B.9. Energy Consumption and Peak Power Demand in Scottsbluff. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	5.6	46.4	4.9	48.9
Air latent energy [kWh_{th}]	0.6	0.4	0.5	0.3
Water sensible energy [kWh_{th}]	34.1	-	34.2	-
Chiller energy [kWh_e]	13.4	15.6	13.2	16.4
Fan energy [kWh_e]	1.3	7.4	1.0	8.5
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	14.9	23.0	14.4	24.9
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.30	1.68	0.30	1.68
Air latent [kW_{th}]	0.30	0.21	0.30	0.24
Water sensible [kW_{th}]	1.08	-	1.11	-
Fan and pump [kW_e]	0.03	0.22	0.03	0.22
Peak load [kW_e]	0.59	0.85	0.60	0.86

TABLE B.10. Energy Consumption and Peak Power Demand in Salt Lake City. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	4.5	64.5	3.9	66.1
Air latent energy [kWh_{th}]	0.0	0.0	0.0	0.0
Water sensible energy [kWh_{th}]	51.6	-	51.7	-
Chiller energy [kWh_e]	18.7	21.5	18.5	22.0
Fan energy [kWh_e]	1.3	8.9	1.0	9.7
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	20.2	30.4	19.7	31.7
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.36	1.86	0.36	1.92
Air latent [kW_{th}]	0.00	0.00	0.00	0.00
Water sensible [kW_{th}]	1.38	-	1.41	-
Fan and pump [kW_e]	0.03	0.23	0.03	0.23
Peak load [kW_e]	0.61	0.85	0.62	0.87

TABLE B.11. Energy Consumption and Peak Power Demand in Seattle. SW orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:				
Air sensible energy [kWh_{th}]	0.6	23.9	0.6	27.6
Air latent energy [kWh_{th}]	0.5	0.4	0.4	0.4
Water sensible energy [kWh_{th}]	31.7	-	31.6	-
Chiller energy [kWh_e]	10.9	8.1	10.9	9.3
Fan energy [kWh_e]	1.3	5.1	1.0	6.3
Pump energy [kWh_e]	0.2	-	0.2	-
Weekly energy consumption [kWh_e]	12.4	13.2	12.1	15.6
Results for the week of system peak:				
Peak load components				
Air sensible [kW_{th}]	0.21	1.35	0.21	1.38
Air latent [kW_{th}]	0.06	0.06	0.06	0.06
Water sensible [kW_{th}]	1.02	-	1.05	-
Fan and pump [kW_e]	0.03	0.20	0.03	0.20
Peak load [kW_e]	0.46	0.67	0.47	0.68

TABLE B.12. Energy Consumption and Peak Power Demand in New Orleans. NE orientation, new building construction.

	RC system continuous ventilation	All-air system continuous ventilation
Results for the typical week:		
Air sensible energy [kWh_{th}]	10.6	46.7
Air latent energy [kWh_{th}]	45.2	48.3
Water sensible energy [kWh_{th}]	30.5	-
Chiller energy [kWh_e]	28.7	31.7
Fan energy [kWh_e]	1.3	3.9
Pump energy [kWh_e]	0.2	-
Weekly energy consumption [kWh_e]	30.2	35.6
Results for the week of system peak:		
Peak load components		
Air sensible [kW_{th}]	0.27	1.23
Air latent [kW_{th}]	0.69	0.66
Water sensible [kW_{th}]	0.87	-
Fan and pump [kW_e]	0.03	0.16
Peak load [kW_e]	0.64	0.79

TABLE B.13. Energy Consumption and Peak Power Demand in Phoenix. NE orientation, new building construction.

	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:		
Air sensible energy [kWh_{th}]	13.5	83.7
Air latent energy [kWh_{th}]	0.0	0.0
Water sensible energy [kWh_{th}]	52.6	-
Chiller energy [kWh_e]	22.0	27.9
Fan energy [kWh_e]	1.0	9.5
Pump energy [kWh_e]	0.2	-
Weekly energy consumption [kWh_e]	23.2	37.4
Results for the week of system peak:		
Peak load components		
Air sensible [kW_{th}]	0.27	1.83
Air latent [kW_{th}]	0.42	0.39
Water sensible [kW_{th}]	1.41	-
Fan and pump [kW_e]	0.03	0.21
Peak load [kW_e]	0.73	0.95

TABLE B.14. Energy Consumption and Peak Power Demand in New Orleans. SW orientation, old building construction.

	RC system continuous ventilation	All-air system continuous ventilation
Results for the typical week:		
Air sensible energy [kWh_{th}]	14.4	104.0
Air latent energy [kWh_{th}]	35.3	35.5
Water sensible energy [kWh_{th}]	69.3	-
Chiller energy [kWh_e]	39.7	46.5
Fan energy [kWh_e]	1.3	9.8
Pump energy [kWh_e]	0.4	-
Weekly energy consumption [kWh_e]	41.4	56.3
Results for the week of system peak:		
Peak load components		
Air sensible [kW_{th}]	0.30	2.67
Air latent [kW_{th}]	0.54	0.54
Water sensible [kW_{th}]	1.92	-
Fan and pump [kW_e]	0.04	0.36
Peak load [kW_e]	0.96	1.43

TABLE B.15. Energy Consumption and Peak Power Demand in Phoenix. SW orientation, old building construction.

	RC system no ventilation at night	All-air system no ventilation at night
Results for the typical week:		
Air sensible energy [kWh_{th}]	20.8	160.9
Air latent energy [kWh_{th}]	0.1	0.1
Water sensible energy [kWh_{th}]	86.1	-
Chiller energy [kWh_e]	35.7	53.7
Fan energy [kWh_e]	1.0	13.7
Pump energy [kWh_e]	0.4	-
Weekly energy consumption [kWh_e]	37.1	67.4
Results for the week of system peak:		
Peak load components		
Air sensible [kW_{th}]	0.42	4.32
Air latent [kW_{th}]	0.21	0.24
Water sensible [kW_{th}]	2.52	-
Fan and pump [kW_e]	0.04	0.58
Peak load [kW_e]	1.09	2.10